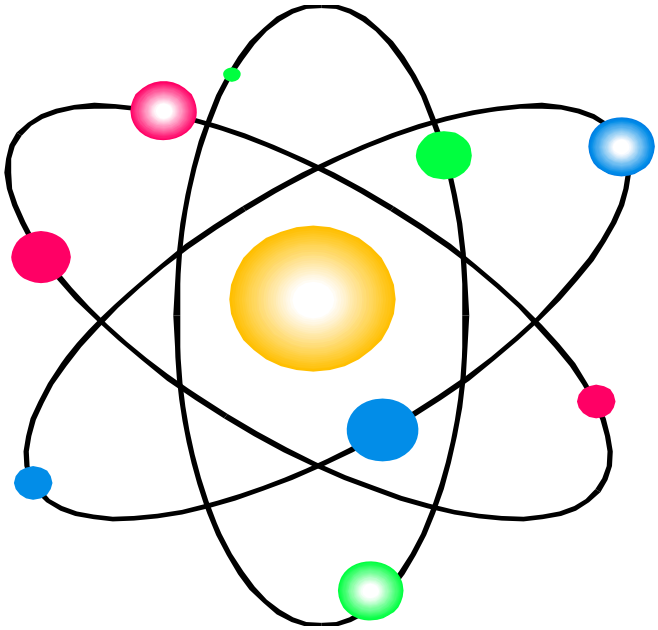
Medical Physics
Procedures Manual
(AMP Manual)



University of Cincinnati

AMP MANUAL
RECORD OF REVISIONS PAGE

UNIVERSITY OF CINCINNATI
MEDICAL PHYSICS MANUAL
(AMP MANUAL)

Revision No.	Date of Revision	Changes Entered
Original	5/05	None
1	8/17/05	Corrected some errors noted after approval of initial manual; added definition of annual
2	11/16/05	Incorporated medical physicist duties for LDR brachytherapy originally delegated to the Director of Radiation Oncology
3	5/17/06	Deleted all references to The University Hospital/TUH. TUH separated from the RCSP. The effective date of the revision is 6/17/06, the effective date of the separation.
4	11/8/06	Deleted references to HDR and Sr-90 eye applicators (these sources were transferred to TUH). Added allowance for use of manufacturer or AAPM calibrator information for determining source strength (allowed by regulation for conventional brachytherapy). Added allowance for shielding evaluation and testing to be performed by CRE. Clarified “survey” requirements covered under AMP task responsibilities are those not performed by RSOf staff. Added some additional minor clarifications.

AMP MANUAL
TABLE OF CONTENTS

AMP MANUAL
LIST OF ACRONYMS USED

AAPM	American Association of Physicists in Medicine
ALARA	As Low As Reasonably Achievable
ALI	Annual Limit on Intake
AMP	Authorized Medical Physicist
AU	Authorized User
CFR	Code of Federal Regulations
CCHMC	Cincinnati Children's Hospital Medical Center
CPM	Counts Per Minute
CRE	Certified Radiation Expert
DOT	United States Department of Transportation
DPM	Disintegrations Per Minute
EDS	Eating, drinking, and smoking
HDR	High Dose Rate Remote Afterloader
IAEA	International Atomic Energy Agency
IBC	Institutional Biosafety Committee
IRB	Institutional Review Board
NCRP	National Council on Radiation Protection
NRC	United States Nuclear Regulatory Commission
OAC	Ohio Administrative Code
ODH	Ohio Department of Health
OEPA	Ohio Environmental Protection Agency
ORC	Ohio Revised Code
OSL	Optically Stimulated Luminescence dosimeter
PPE	Personal Protective Equipment
QA	Quality Assurance
QMP	Quality Management Program
RAM	Radioactive Material
RCRA	Resource Conservation and Recovery Act
RCSP	Radiation Control and Safety Program
RDRC	Radioactive Drug Research Committee
RGE	Radiation Generating Equipment
RS	Radiation Safety
RSC	Radiation Safety Committee
RSO	Radiation Safety Officer
RSOf	Radiation Safety Office
RW	Radiation Worker
SHC	Shriner's Burns Hospital for Children
TEDE	Total Effective Dose Equivalent
TLD	Thermoluminescent Dosimeter
UC	University of Cincinnati

AMP MANUAL

1. PURPOSE AND SCOPE

1.1. The purpose of this manual is to supplement the Radiation Control and Safety Program (RCSP) Manual.

1.1.1. This manual and Authorized Medical Physicists (AMP) requirements were developed to ensure compliance with Ohio Department of Health (ODH) regulations.

1.1.2. This manual is intended to provide both general and specific instructions to AMPs and their supervised radioactive material (RAM) radiation workers (RW).

1.1.3. This manual is a compilation of relevant rules and regulations, policies, guidelines, and procedures to be used as a daily reference for the AMP.

1.1.4. All requirements within this manual are offered to assure compliance with applicable regulations contained in rules of the ODH, and specific conditions of UC's type A broad scope license.

1.1.4.1. Current copies of the regulations, registrations and licenses are maintained in the Radiation Safety Office (RSOf).

1.1.4.2. Current copies of regulations are available on the ODH website www.odh.state.oh.us.

1.1.5. Any policies and procedures in this manual should be considered as a supplement to departmental policy and procedures manuals with specific guidance offered in ODH rules and the conditions of UC's type A broad scope license.

1.1.5.1. The medical uses of radiopharmaceuticals and sealed sources for human-use diagnostic and therapeutic procedures are governed by regulations contained in ODH rules and UC's type A broad scope license.

1.1.5.2. To closely monitor applicable human uses of RAM, the Division of Radiation Oncology will be audited by RSOf representatives on a quarterly basis. RSOf audits shall cover, at a minimum: general RCSP requirements, the Quality Management Program (QMP) and the policies and procedures included in this manual. Contact the chair of the referenced division or the RSOf for additional information.

2. AUTHORIZATION REQUIREMENTS

2.1. Before procedures requiring AMP authorization may be performed under the University Radiation Control and Safety Program (RCSP) a UC authorization to perform AMP tasks must be established or an individual must perform the tasks under the supervision of an AMP approved by the RSC to supervise the task. The RCSP covers ionizing radiation usage at UC campuses, Cincinnati Children's Hospital Medical Center (CCHMC), Shriner's Burn Hospital for Children (SHC) and the Hoxworth Blood Center.

3. ESTABLISHING AN AUTHORIZATION FOR AUTHORIZED MEDICAL PHYSICIST (AMP)

3.1. To establish an authorization, the Authorized Medical Physicist (AMP) applicant must complete the application process outlined in the following paragraphs.

3.2. AMP Qualifications. The prospective AMP must meet the qualifications for the proposed use.

3.2.1. Be a full time faculty member at the University of Cincinnati or a full-time faculty member at Children's Hospital Medical Center, paid or unpaid by the University or a full-time faculty member at the Shriner's Burns Hospital for Children, paid or unpaid by the University, or a full-time faculty member at the Hoxworth Blood Center paid or unpaid by the University, or emeritus professor at one of the above institutions with AU status at the time of emeritus appointment or a full-time paid employee (UC, Children's, Shriner's or Hoxworth) holding the rank of UC Research Associate or Research Scientist, with or without parenthetical rank or hold a full-time faculty position at the University and be paid by an institution under contract/affiliation with the University, or be named Radiation Safety Officer (RSO) or Assistant Radiation Safety Officer (ARSO) for the University of Cincinnati, or

3.2.2. Be a full time staff member of Children's Hospital Medical Center or Shriner's Burns Hospital for Children with the title of medical physicist, with or without parenthetical rank, and have their credentials verified by the Medical Director of Radiology or Radiation Oncology.

3.2.3. Possess and document training and experience as required by the RSC.

3.2.3.1. For radioactive material the requirements include those listed in OAC 3701:1-58-19.

3.3. Notifications

3.3.1. Notify the RSOf of the intent to apply for AMP status, obtain an AMP packet and submit appropriate materials to the RSO for review and submission to the RSC.

3.4. Application

3.4.1. The AMP Application shall include

3.4.1.1. Complete RS Form 35, "Application for Authorized Medical Physicist".

3.4.1.2. Documentation of past training and experience as required by the RSC.

3.4.2. Submit the application and past experience/training documentation to the RSOf in advance or at the time of the RSO interview.

3.5. AMP and Site-specific Training

3.5.1. AMP Training and Preparation

3.5.1.1. Completion of AMP training.

3.5.1.1.1. Obtain and review copies of the Medical Physicist Procedures Manual (AMP Manual)

3.5.1.1.2. Review OAC 3701:1-38.

3.5.1.1.3. Review OAC 3701:1-58.

3.5.1.1.4. Review UC's QMP.

3.5.2. Site-Specific Training

3.5.2.1. Successfully complete UC's AMP-specific training program.

3.5.2.2. Site-specific training must be completed prior to AMP authorization approval.

3.6. RSO Discussion

3.6.1.1. The applicant and the RSO will discuss the roles and responsibilities of the AMP, RWs and the RSOf.

3.7. Approval of AMP Application by RSC

3.7.1. Upon successful completion of the above requirements, the RSO will seek approval of the application by the RSC at its next meeting.

3.7.2. On a case-by-case basis, temporary approval may be granted by an RSC executive committee pending review/approval by the full RSC at its next meeting.

3.8. Qualifying a RAM Radiation Worker - (RAM RW).

3.8.1. Only RAM RWs may perform AMP tasks delegated by an AMP.

3.8.2. All RAM RWs who are assigned to work under the supervision of an AMP shall also be assigned to work under the supervision of a human use authorized user (AU). For each RAM RW, the AMP shall do the following.

3.8.2.1. Obtain a copy of UC's RW Training Manual for review by the proposed RAM RW.

3.8.2.2. Arrange for the proposed RAM RW to attend UC's site-specific training courses given by the RSOf. (Note: A training certificate is provided to each individual who successfully completes site-specific training.)

3.8.2.3. Ensure the proposed RAM RW has provided the RSOf authorization to obtain a complete exposure history (AUTHORIZATION AND CERTIFICATION SECTION of RS Form 2.0).

3.8.2.4. Ensure all (male and female) RAM RWs have reviewed and understand Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure" (Note: This regulatory guide is reviewed at the site-specific training required of all RAM RWs).

3.8.2.5. Conduct and document procedure specific training. Procedure specific training must include the AMP reviewing with the RAM RW the following items.

3.8.2.5.1. Previous training and experience in radiation safety and use of radiation source(s).

3.8.2.5.2. Any applicable licensure the individual may possess.

3.8.2.5.3. Medical physics procedures to be performed and the associated radiation source(s).

3.8.2.5.4. Procedures for safe use of radiation source(s).

3.8.2.5.5. Applicable emergency plans and procedures and associated drills.

3.8.2.5.6. Reportable medical events (a.k.a. misadministrations).

3.8.2.5.7. Record-keeping requirements.

3.8.2.5.8. The AMP's authorization and any recent non-compliances received by the department and/or division.

3.8.2.6. After successful completion of the training requirements, and upon receipt of the appropriate personnel dosimeter the worker may perform RAM medical physics tasks under the supervision of the AMP. (Tasks limited to those that do not specifically have to be performed by an AMP)

3.8.2.7. To maintain RAM RW status, each RAM RW must attend at least one radiation safety training session each calendar year. These sessions will be provided through the RSOf.

3.8.2.8. To reestablish RAM RW status, an individual must be up-to-date on their RAM RW training.

3.8.2.8.1. Individuals who last attended site-specific training or an appropriate retraining session three years ago or less may bring their training status up-to-date by attending a site-specific or an appropriate retraining course.

3.8.2.8.2. Individuals who last attended site-specific training or an appropriate retraining over three years ago must bring their training status up-to-date by attending a site-specific training course.

3.8.3. Training Record Maintenance

3.8.3.1. The AMP must maintain a copy of all AMP procedure specific training conducted. It is recommended a copy be sent to the RSOf.

3.8.3.1.1. The AMP must maintain training records of RAM RWs as long as an individual is listed as a RAM RW under the authorization.

3.8.3.1.2. For each RAM RW who may operate a HDR, the AMP must also maintain training records covering HDR operating and emergency procedures training and associated drills.

3.8.3.1.2.1. The record shall include a list of the topics/drill items covered, the date of instruction, the name(s) of the attendee(s) and the name(s) of the individual(s) who conducted the training.

3.8.3.1.2.2. A copy of training records shall be provided to the RSOf for inclusion in each individual's RAM RW file.

3.8.3.2. The RSOf will maintain a file for each RAM RW containing documentation of all site-specific training, retraining, and/or any RSOf conducted special training attended. This record may also be used to file other documentation, such as, RS Form 2.0s, bioassay reports, dosimetry reports, or other correspondence relating to an individual RAM RW.

3.8.4. Persons under the age of 18 (minors) are bound by more restrictive regulations governing allowable exposure limits, and in general must be escorted while in RAM or RGE use areas. Contact the RSOf for additional information.

4. AMP TASKS

4.1. Each AMP is responsible for performing and/or supervising and assuring the following tasks are performed, as applicable to procedures listed within their AMP authorization. Some tasks, by regulation must be performed by an AMP. AMPs must ensure these tasks ARE NOT delegated.

4.1.1. Develop equipment specifications for radiation therapy treatment, brachytherapy, simulation and therapeutic radiation detection and assure equipment is only used within specifications, as needed by the types of radiation therapy treatment (e.g., brachytherapy) being performed. At a minimum, these specifications shall include the following.

4.1.1.1. the source-specific input parameters required by the dose calculation algorithms

4.1.1.2. the accuracy of dose, dwell times and treatment time calculations at representative points

4.1.1.3. the accuracy of isodose plots and graphic displays

4.1.1.4. the accuracy of the software used to determine sealed source positions from radiographic images

4.1.2. Develop procedures for the initial and continuing evaluation of equipment for radiation treatment, brachytherapy, simulation and therapeutic radiation detection, as needed by the types of radiation therapy treatment (e.g., brachytherapy) being performed, and assure the procedures are followed.

4.1.3. Develop and routinely evaluate policies and procedures and assure the policies and/or procedures are followed. At a minimum these policies and/or procedures shall include the following. When applicable these policies and/or procedures should be evaluated in conjunction with an AU approved for the associated clinical use of radiation.

4.1.3.1. Policies and /or procedures to routinely, mathematically correct outputs or activities of brachytherapy sources for radioactive decay consistent with at least 1% radioactive decay. For commonly used brachytherapy sources this requires mathematical correction of:

4.1.3.1.1. I-125 each day of use

4.1.3.1.2. Ir-192 each day of use

4.1.3.1.3. Pd-103 each day of use

4.1.3.2. Policies and/or procedures to assure source manipulation during preparation for implant do not result in a leaking source implanted into a patient. This shall at a minimum include:

4.1.3.2.1. Procedures for identifying and immediately leak testing sources outside the standard frequency in situations involving manipulation of the sources that could or visually appears to have resulted in damage to the source.

4.1.3.3. Procedures to ensure surveys of the patient or human research subjects and areas surrounding the patient are performed as necessary and if a survey is not performed by the RSOf records of the survey are forwarded to the RSOf. At a minimum surveys shall be performed:

4.1.3.3.1. immediately following implant

4.1.3.3.2. immediately following source removal

4.1.4. Perform acceptance testing of any equipment used for radiation therapy treatment, brachytherapy, simulation and therapeutic radiation detection in accordance with nationally recognized standards and/or manufacturer guidelines as it applies to brachytherapy.

4.1.5. Measure and characterize medical radiation from radiation therapy treatment, brachytherapy, simulation and therapeutic radiation detection prior to clinical use in accordance with nationally recognized standards as it applies to brachytherapy.

4.1.6. Perform acceptance testing and evaluation of radiation oncology computer systems, their algorithms, data and output, in accordance with nationally recognized standards as it applies to brachytherapy.

4.1.7. Perform decay calculations and where applicable, ensure correct decay of source(s) activity in the associated computer system(s) and maintain appropriate records as it applies to brachytherapy.

4.1.8. Ensure a calibrated dosimetry system is used for determining source output and for spot-checks of output measurements and appropriate records of calibrations are maintained. The calibrated dosimetry system may be a RCSP system, a source manufacturer system or an American Association of Physicists in Medicine (AAPM) accredited calibration laboratory system. For dosimetry system to be considered “calibrated” it shall either have been calibrated:

4.1.8.1. within the last two years and after any servicing that may affect the calibration, using system or source traceable to the National Institute of Standards and Technology (NIST) and published protocols accepted by nationally recognized bodies or

4.1.8.2. within the last 24 months and after any servicing that may affect the calibration by a laboratory accredited by the American Association of Physicists in Medicine (AAPM) or

4.1.8.3. within the last four years and 18 to 30 months after the calibration the system was intercompared with another dosimetry system that was calibrated within the last 24 months by NIST or a calibration laboratory accredited by AAPM and the results of the intercomparison

4.1.8.3.1. indicated the calibration factor has not changed by more than 2%

4.1.8.3.2. indicated no change to the calibration factors and

4.1.8.3.3. included the use of a comparable unit with beam attenuations or collimators, as applicable, and sources of the same radionuclides

4.1.9. Ensure Radiation Oncology departmental compliance to general RCSP policies and procedures and accepted good practice. These include, but are not limited to,

4.1.9.1. posting requirements as listed in section 5 of the Radiation Protection Procedures Manual (AU manual)

4.1.9.2. good laboratory practice as listed in section 5 of the Radiation Protection Procedures Manual (AU manual)

4.1.9.3. personnel protection as listed in section 7 of the Radiation Protection Procedures Manual (AU manual)

4.1.9.4. personnel monitoring as listed in section 8 of the Radiation Protection Procedures Manual (AU manual)

4.1.9.5. use of personal protective equipment (PPE) as listed in section 9 of the Radiation Protection Procedures Manual (AU manual)

4.1.9.6. record-keeping and reports as listed in this manual and section 12 of the Radiation Protection Procedures Manual (AU manual) and OAC 3701:1-58

4.1.10. As it applies to brachytherapy, plan and specify the thickness, material and placement of shielding needed to protect workers, patients and the general public from radiation produced incident to diagnosis or treatment of humans and review new installations or changes to installations with the RSO.

4.1.11. As it applies to brachytherapy, perform initial assessments and evaluations of shielding designed to protect workers, patients and the general public from radiation produced incident to diagnosis and treatment of humans.

4.1.12. Oversee departmental compliance to RCSP and regulatory requirements listed in the QMP and OAC 3701:1-58, including the following:

4.1.12.1. Evaluate procedures involving the therapeutic use of radiation prior to clinical use.

4.1.12.2. At least weekly, review dosimetry information noted in patient records.

4.1.12.3. At least annually, evaluate the division’s clinical radiation safety program.

4.1.12.4. Ensure possible medical events and/or reportable incidents are brought to the immediate attention of the prescribing and/or AU physician and the RSO.

4.1.12.5. Ensure the RSO and the AU is notified immediately if the patient or human research subject has a medical emergency or dies.

4.1.12.6. Ensure departmental RAM RWs are appropriately trained and act as a technical resource for RAM RWs within the AMP’s department.

4.1.12.7. Ensure survey meters are calibrated annually and RAM RWs are trained in their proper operation.

4.1.13. Provide consultation on patient radiation dose and associated risks.

5. RSOf AUDITS

5.1. AMP Authorizations Review

5.1.1. Each quarter or more frequently at the discretion of the RSO, a representative of the RSOf will conduct an audit for the purpose of determining overall regulatory compliance and specific compliance with ODH rules. These audits are performed at the department and/or division level.

5.1.2. AMP authorizations and tasks shall be included within the department and/or division audits. (See Radiation Protection Procedures Manual (AU manual) section 6.2 for more details)

5.2. Special Rules for Retraining

5.2.1. If any AMP is not retrained by the last scheduled retraining class during a calendar year, the AMP authorization shall be suspended effective January 1.

5.2.1.1. If the AMP still has not met their previous year's retraining obligation by the first RSC meeting of the new calendar year, the RSC shall terminate the AMP's RW and authorization status. Reapplication of the AMP's RW and/or authorization shall require the AMP to complete the initial site-specific training.

5.2.1.2. Any RAM RW who does not attend retraining by the last scheduled retraining class during a calendar year will be suspended from working with RAM on January 1 until retraining is accomplished.

5.2.1.3. If a RAM RW has not met their previous year's retraining obligation by the first RSC meeting of the new calendar year, the RSC shall terminate the RAM RW status. Reapplication of the RAM RW status shall require the individual to complete the initial site-specific training course.

5.2.2. If a suspended AMP or RAM RW is found performing tasks of a medical physicist or working with (using) RAM, the AMP shall be required to meet with the RSC and provide explanation and corrective action.

6. RECORDS

6.1. Maintain records of calibration of brachytherapy sources for at least 3 years and these records shall, at a minimum, include:

6.1.1. the date of calibration

6.1.2. the manufacturer's name, model and serial number for the source and the instruments used to calibrate the source

6.1.3. the source output or activity

6.1.4. the source positioning accuracy within the applicators and

6.1.5. the name of the individual, the source manufacturer or the calibration laboratory that performed the calibration.

6.2. Records of RCSP dosimetry equipment calibration, intercomparison and comparison shall be maintained for the life of the license. Copies of the calibrations shall be forwarded to the Radiation Safety Office on an annual basis and shall include:

6.2.1. the date

6.2.2. the manufacturer's name, model number, serial numbers of the instruments calibrated, intercompared or compared

6.2.3. the correction factor determined from the calibration or comparison or the apparent factor that was determined from an intercomparison

6.2.4. the names of the individual(s) who performed the calibration, intercomparison or comparison

6.3. Records of surveys for source implant and source removal performed by an individual other than a RSOf staff members shall be forwarded to the RSOf and each record shall include:

6.3.1.1. the date and results of the survey

6.3.1.2. the survey instrument used

6.3.1.3. the name of the individual who performed the survey

AMP MANUAL
APPENDIX I: RADIATION SAFETY FORMS

RS FORM 2.0	RADIATION WORKER/DOSIMETRY APPLICATION
RS FORM 2.2	DOCUMENTATION OF AMP MEDICAL PHYSICS SPECIFIC RADIATION WORKER TRAINING/INTERVIEW
RS FORM 4	NON-COMPLIANCE RESPONSE FORM
RS FORM 7	RADIATION INCIDENT REPORT
RS FORM 10A	RAM TRANSFER REQUEST
RS FORM 10B	I-125 RAM TRANSFER REQUEST
RS FORM 14	RADIOACTIVE MATERIAL REQUEST
RS FORM 19	EMERGENCY NOTIFICATION
RS FORM 33	DECLARATION OF PREGNANCY
RS FORM 35	APPLICATION FOR AUTHORIZED MEDICAL PHYSICIST

COPIES OF FORMS ARE AVAILABLE
FROM THE RADIATION SAFETY OFFICE
and
ON THE RSOf WEBSITE AT WWW.UC.EDU/RADSAFETY

AMP MANUAL
APPENDIX II: GLOSSARY OF TERMS

AAPM American Association of Physicists in Medicine

Absorbed dose means the energy imparted by ionizing radiation per unit mass of irradiated material. The units of absorbed dose are the rad and the gray (Gy). 1 Gy = 100 rad.

Activity is the rate of disintegration (transformation) or decay of radioactive material. The units of activity are the curie (Ci) and the becquerel (Bq). 1 Bq = 2.7×10^{-11} Ci.

ALARA (acronym for "as low as is reasonably achievable") means making every reasonable effort to maintain exposures to radiation as far below the dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

ALI (acronym for "Annual Limit on Intake") means the derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rem (0.05 Sv) or a committed dose equivalent of 50 rem (0.5 Sv) to any individual organ or tissue.

Annual means once per year, at about the same time each year, plus or minus one month.

AU Authorized User

AMP Authorized Medical Physicist

Background radiation means radiation from cosmic sources; naturally occurring radioactive materials, including radon (except as a decay product of source or special nuclear material) and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. "Background radiation" does not include radiation from source, byproduct, or special nuclear materials regulated by the Nuclear Regulatory Commission.

Becquerel is an SI unit of measurement of radioactivity equal to one transformation per second. 1 Bq = 2.7×10^{-11} Ci.

Bioassay (radiobioassay) means the determination of kinds, quantities or concentrations, and, in some cases, the locations of radioactive material in the human body, whether by direct measurement (in vivo counting) or by analysis and evaluation of materials excreted or removed from the human body.

Brachytherapy source means an individual sealed source or a manufacturer-assembled source train that is not designed to be disassembled by the user and which is to be used for brachytherapy.

Byproduct material means any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or utilizing special nuclear material.

Calibration is the check or correction of the accuracy of a measuring instrument to assure proper operational characteristics.

CFR Code of Federal Regulations

CCHMC Cincinnati Children's Hospital Medical Center

Committed dose equivalent ($H_{T,50}$) means the dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

Committed effective dose equivalent ($H_{E,50}$) is the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues ($H_{E,50} = \sum W_T H_{T,50}$)

Contamination is the deposition of unwanted radioactive material on the surfaces of structures, areas, objects, or personnel.

Controlled areas are areas, outside of restricted areas but inside the site boundary, access to which can be limited by the licensee for any reason.

CPM Counts Per Minute

Declared pregnant woman means a woman who has voluntarily informed the licensee, in writing, of her pregnancy and the estimated date of conception. The declaration remains in effect until the declared pregnant woman withdraws the declaration in writing or is no longer pregnant.

Decontamination is the reduction or removal of radioactive material from a structure, area, object, or person. Decontamination may be accomplished by treating the area to remove or reduce contamination or by allowing the radioactive material to decay.

Deep-dose equivalent (H_d), which applies to external whole-body exposure, is the dose equivalent at a tissue depth of 1 cm (1000 mg/cm^2).

Dose equivalent (H_T) means the product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and sievert (Sv). 1 Sv = 100 rem.

DOT United States Department of Transportation

DPM Disintegrations Per Minute

Effective dose equivalent (H_E) is the sum of the products of the dose equivalent to the organ or tissue (H_T) and the weighting factors (W_T) applicable to each of the body organs or tissues that are irradiated ($H_E = \sum W_T H_T$).

EDS Eating, Drinking, or Smoking

Exposure means being exposed to ionizing radiation or to radioactive material.

External dose means that portion of the dose equivalent received from radiation sources outside the body.

Extremity means hand, elbow, arm below the elbow, foot, knee, or leg below the knee.

Film badge is a pack of photographic film used for approximate measurement of radiation exposure for personnel monitoring purposes.

Gray (Gy) is the SI unit of absorbed dose. One gray is equal to an absorbed dose of 1 Joule/kilogram (100 rads). 1 Gy = 100 rads.

HDR High Dose Rate Remote Afterloader

High radiation areas are areas, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.1 rem (1 mSv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

IAEA International Atomic Energy Agency

IBC Institutional Biosafety Committee

Individual monitoring devices (individual monitoring equipment) means devices designed to be worn by a single individual for the assessment of dose equivalent such as film badges, thermoluminescence dosimeters (TLDs), pocket ionization chambers, and personal ("lapel") air sampling devices.

IRB Institutional Review Board

Internal dose means that portion of the dose equivalent received from radioactive material taken into the body.

Lens dose equivalent (LDE) applies to the external exposure of the lens of the eye and is taken as the dose equivalent at a tissue depth of 0.3 centimeter (300 mg/cm^2)

Lost or missing licensed material means licensed material whose location is unknown. It includes material that has been shipped but has not reached its destination and whose location cannot be readily traced in the transportation system.

Member of the public means any individual except when that individual is receiving an occupational dose.

Minor means an individual less than 18 years of age.

NCRP National Council on Radiation Protection

Nonstochastic effect means health effects, the severity of which varies with the dose and for which a threshold is believed to exist. Radiation-induced cataract formation is an example of a nonstochastic effect (also called a deterministic effect).

NRC United States Nuclear Regulatory Commission

Occupational dose means the dose received by an individual in the course of employment in which the individual's assigned tasks involve exposure to radiation or to radioactive material from licensed and unlicensed sources of radiation, whether in the possession of the licensee or other person. Occupational dose does not include dose received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with ODH rules, from voluntary participation in medical research programs, or as a member of the public.

OAC Ohio Administrative Code

OEPA Ohio Environmental Protection Agency

ODH Ohio Department of Health

ORC Ohio Revised Code

OSL Optically Stimulated Luminescence dosimetry

PPE Personal Protective Equipment

Public dose means the dose received by a member of the public from exposure to radiation, or radioactive material released by a licensee, or to any other source of radiation under the control of a licensee. Public dose does not include occupational dose or doses received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with ODH rules, or from voluntary participation in medical research programs.

QA Quality Assurance

QMP Quality Management Program

Quality factor (Q) means the modifying factor (listed in ODH rule 3701:1-38) that is used to derive dose equivalent from absorbed dose.

Rad is the special unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs/gram or 0.01 Joule/kilogram (0.01 gray). 1 rad = 0.01 Gy.

Radiation (ionizing radiation) means alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. Radiation, as used in this manual, does not include non-ionizing radiation, such as radio- or microwaves, or visible, infrared, or ultraviolet light.

Radiation areas are areas, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem (0.05 mSv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

Radioactive Waste is any radioactive material (RAM) or items that contain or are contaminated with RAM that are no longer useful.

RAM Radioactive Material

RCRA Resource Conservation and Recovery Act

RCSP Radiation Control and Safety Program

RDRC Radioactive Drug Research Committee

Rem is the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor (1 rem=0.01 sievert).

RGE Radiation Generating Equipment

Restricted areas are areas, access to which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. Restricted areas do not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.

RS Radiation Safety

RSC Radiation Safety Committee

RSO Radiation Safety Officer

RSOf Radiation Safety Office

RW Radiation Worker

SHC Shriner's Burns Hospital for Children

Sealed source is radioactive material that is permanently bonded or fixed in a capsule or matrix designed to prevent release and dispersal of the radioactive material under the most severe conditions which are likely to be encountered in normal use and handling.

Shallow-dose equivalent (H_s), which applies to the external exposure of the skin or an extremity, is taken as the dose equivalent at a tissue depth of 0.007 centimeter (7 mg/cm^2) averaged over an area of 1 square centimeter.

Sievert is the SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor (1 Sv=100 rems).

Site boundary means that line beyond which the land or property is not owned, leased, or otherwise controlled by the licensee.

Stochastic effects means health effects that occur randomly and for which the probability of the effect occurring, rather than its severity, is assumed to be a linear function of dose without threshold. Genetic mutations and the induction of cancer are examples of stochastic effects.

Survey means an evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation. When appropriate, such an evaluation includes a physical survey of the location of radioactive material and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present.

Survey meter is any portable radiation detection instrument especially adapted for inspecting an area to establish the existence and amount of radioactive material present.

TEDE Total Effective Dose Equivalent

TLD Thermoluminescent Dosimeter

Total Effective Dose Equivalent (TEDE) means the sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

UC University of Cincinnati

Unrestricted areas are areas, access to which is neither limited nor controlled by the licensee.

Unsealed source is radioactive material which is not permanently bonded or fixed in a capsule or matrix designed to prevent release and dispersal of the radioactive material.

Very high radiation area means an area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in 1 hour at 1 meter from a radiation source or 1 meter from any surface that the radiation penetrates.

Weighting factor (W_T), for an organ or tissue (T) is the proportion of the risk of stochastic effects resulting from irradiation of that organ or tissue to the total risk of stochastic effects when the whole body is irradiated uniformly. The values of W_T for various organs or tissue are in ODH rule 3701:1-38.

Whole body means, for purposes of external exposure, head, trunk, (including male gonads),

arms above the elbow, or legs above the knee.

APPENDIX III: DEFINITION OF A MEDICAL EVENT

Medical event means, except for an event that results from patient intervention, in which the administration or radioactive material or radiation from radioactive material results in:

1.0 A dose that differs from the prescribed dose or dose that would have resulted from the prescribed dosage by more than 5 rem (0.05 sievert) effective dose equivalent, 50 rem (0.5 sievert) to an organ or tissue or 50 rem (0.5 sievert) shallow dose equivalent to the skin and

1.1. a total dose delivered differs from the prescribed dose by 20% or more

1.2. the total dosage delivered differs from the prescribed dosage by 20% or more or falls outside the prescribed dosage range or

1.3. the fractionated dose delivered differs from the prescribed dose, from a single fraction by 50% or more

2.0 A dose that exceeds 5 rem (0.05 sievert) effective dose equivalent, 50 rem (0.5 sievert) to an organ or tissue or 50 rem (0.5 sievert) shallow dose equivalent to the skin from any of the following:

2.1. an administration of a wrong radioactive drug containing radioactive material

2.2. an administration of a radioactive drug containing radioactive material by the wrong route of entry

2.3. an administration of a dose or dosage to the wrong individual or human research subject

2.4. an administration of a dose or dosage delivered by the wrong mode of treatment or

2.5. a leaking sealed source

A dose to the skin or an organ or tissue other than the treatment site that exceeds 50 rem (0.5 sievert) to an organ or tissue and 50% or more of the dose expected from the administration defined in the written directive (excluding, for permanent implants, seeds that were implanted in the correct site but migrated out